2013 Hawaii University International Conferences
Education & Technology
Math & Engineering Technology
June 10th to June 12th
Ala Moana Hotel, Honolulu, Hawaii

# Sensitivity Analysis of a Three-Species Nonlinear Response Omnivory Model

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**Abstract:** We investigate a three-species omnivory model with non-linear Holling Type II functional and numerical responses. Our coupled system of differential equations incorporates the definition of omnivory—feeding on more than one trophic level—using thirteen model parameters and three state variables. The state variables correspond to species densities for a top predator, an intermediate consumer and a basal resource. As estimates from natural systems, the model parameters are subject to natural intrinsic variability and measurement error. We use sensitivity analysis to determine how infinitesimal changes in parameters, corresponding to variability and error, affect the population densities. We apply theorems on continuous dependence and differentiability with respect to parameters to our model to derive sensitivity equations. After solving the sensitivity equations which are forced by the original coupled system we compare the sensitivities using a weighted norm. Our comparison shows that small changes in the top predator mortality rate cause the greatest change in the species densities. Thus, biologists should take extra care in the field to accurately collect data to determine the top predator mortality rate. Also, we determine the least sensitive parameter to be the top predator handling time of the intermediate consumer. Overall, the handling times are less sensitive with the search and mortality rates being the most sensitive.